REMARKS

Claims 25-29, 32-37, 39, 41-43, 46, 47, and 50-58 are currently pending in this application. Claims 25, 28, 29, 34, 35, 39, 41-43, 46, and 47 have been changed, claims 30, 31, 38, 40, 44-45, 48 and 49 have been cancelled, and claims 50-58 have been added by this amendment. Applicant thanks the Examiner for the interview held 3/18/01 which was made of record by the Examiner.

The Examiner rejected claims 25-49 under the judicially-created doctrine of obviousness-type double patenting as being unpatentable over claims 1-24 of U.S. Patent 6,088,017 as being a broader version of the patented claims. The Examiner also rejected claims 25-49 under the judicially-created doctrine of obviousness-type double patenting as being unpatentable over claims 1-60 of U.S. Patent 6,275,213 as being a broader version of the patented claims. Applicant believes that at least some of the claims are not obvious in view of the claims of these previous patents, but has submitted a terminal disclaimer herewith to expedite prosecution. In view of the foregoing, Applicant respectfully requests that the double patenting rejection be withdrawn.

The Examiner rejected claim 44 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Applicant has amended claim 44 to be dependent on claim 41 as assumed by the Examiner and set forth above, and respectfully requests that the rejection under 35 U.S.C. 112, second paragraph, be withdrawn.

Applicant has amended the claims as indicated below to clarify their scope and terminology and provide better form, and these amendments are not based on or made in response to the rejections mentioned below made by the Examiner with regards to patentability.

The Examiner rejected claims 25-29, 31-37, 40-44, 48, and 49 under 35 U.S.C. 103(a) as being unpatentable over Kramer (Patent No. 5,184,319) in view of McIntosh (Patent No. 5,103,404). Applicant respectfully traverses. Kramer discloses using flexible tendons or cables to force a member or platform against the user. For example, in col. 6, lines 24-37, Kramer describes a force-applying platform that is forced against a finger-tip by an actuator and using a flexible tendon, such as tendon cable 203 in Fig. 2a or cables 520 in Fig. 5a; or by a linkage as shown in Fig. 5L. Alternatively, Kramer describes a tactile pin array 700 in Figs. 7a and 7b, which uses a solenoid to push pins against a user's skin to provide texture sensations. None of these actuators or mechanisms are actuators as recited in claim 25, and Kramer does not disclose or suggest any way of controlling actuators to produce tactile sensations as recited in claim 25

To clarify Applicant's terminology, claim 25 has been amended to recite that the actuator is a rotating-mass actuator including a shaft and eccentric mass that imparts a rotating vector force on the user which creates a tactile sensation perceived as one of a vibration, impulse, and series of impulses as dependent on the speed of rotation and number of rotations of the mass, and where the tactile sensation has a frequency that varies over the duration of the tactile sensation. These features are disclosed on page 3, lines 17-25 and page 5, lines 16-23 of Applicant's specification. Kramer does not disclose or suggest the rotating mass actuators, and also does not disclose or suggest tactile sensations dependent on speed and/or number of rotations, nor varying tactile sensations as claimed in claim 25.

The Examiner also stated that Kramer discloses an inertial mass actuator that selectively generates an inertial vibration that a user can feel when operating the computer peripheral. However, Kramer makes no mention of inertial mass actuators or the control of inertial mass actuators. An inertial mass actuator generates tactile sensations by moving an inertial mass that is generally linked to a structure that is in contact with the user, so that the user feels the sensations; e.g., an eccentric mass can be rotated in space inertially and resulting inertial forces are transmitted to the user. None of these actuators or mechanisms are inertial mass actuators, and Kramer does not disclose or suggest any way of controlling inertial mass actuators to produce tactile sensations as recited in claim 25. Kramer therefore does not disclose or suggest inertial mass actuators even as recited in claim 25 prior to this amendment.

The Examiner also stated that Kramer does not disclose a signal processor, but that McIntosh teaches a signal processor 25 that controls the actuator to produce the vibration by producing an activating signal in response to received data from the host computer. Applicant respectfully traverses. McIntosh discloses a telemanipulator system, and there is no suggestion that the host computer of McIntosh is running a graphical simulation as recited in claim 25 which allows a user to provide input to the graphical simulation. Furthermore, there is no description of the host computer in McIntosh providing data from which the microprocessor generates an activating signal and produces a tactile sensation on the peripheral that provides input to the host computer. Instead, in McIntosh, force developed on a manipulator load motor is directly used to control motors and forces on a user controller (col. 2, lines 64-68, col. 3 lines 1-3). In addition, McIntosh does not disclose inertial mass or rotating mass actuators. McIntosh does not mention outputting any of vibrations, an impulse, and a series of impulses on a peripheral that enables user input to the graphical simulation.

Furthermore, there is no suggestion or motivation in either Kramer or McIntosh to combine the references to achieve applicant's invention of claim 25. In view of the foregoing, claim 25 is therefore believed patentable over Kramer in view of McIntosh.

Claims 26-29, 31-37, and 40 are dependent on claim 25 and are believed patentable for at least the same reasons as claim 25 and for additional reasons. For example, claim 28 recites two rotating-mass actuators, which are not disclosed in Kramer as explained above. Claim 29 recites that the two actuators simultaneously produce the tactile sensation; as described in Applicant's (re-submitted) specification on page 5, lines 21-22, tactile sensations can include vibrating two or more vibrotactile units, which is not disclosed by Kramer in view of McIntosh. Claim 35 recites a compliant spring to amplify vibrations, which is not disclosed or suggested by Kramer in view of McIntosh; the springs of Kramer's Figs. 8a-b and 8f-g are used on tactile pins, where the pins are extended or retracted against the spring. These pins are are not an inertial or rotating mass as explained above. New claim 50 is also dependent on claim 25 and patentable for at least the same reasons and additional reasons, e.g., the series of impulses by repeating pulses is not suggested by Kramer in view of McIntosh and is disclosed in Applicant's specification on, for example, on page 20, lines 26-28.

Claim 41, amended for clarity similarly as explained for claim 25, recites an apparatus including a plurality of rotating-mass actuators that together create a vibrating tactile sensation that is non-uniform over the duration of the tactile sensation, and a signal processor, separate from host computer, which is operative to selectively control the angular velocity of each rotating mass actuator to produce non-uniform vibrations in response to received data from the host computer. Similarly as explained above for claim 25, Kramer and McIntosh do not disclose or suggest inertial mass or rotating-mass actuators, non-uniform vibration tactile sensations, or signal processors as recited in the claim, so that claim 41 is believed patentable thereover. Furthermore, these references do not disclose using a plurality of rotating mass actuators to <u>together</u> create a vibrating tactile sensation. Each extending pin of Kramer, for example, is controlled separately to produce its own sensation on a different area of the user's fingertip; these actuators do not create rotating vector forces that together create a tactile sensation as recited in claim 41.

Dependent claims 42-44 and 48 are dependent on claim 41 and are believed patentable for at least the same reasons as claim 41 and for additional reasons. For example, claim 46 recites that the rotating-mass actuators are controlled in sequence, each actuator having a non-uniform amplitude profile over the duration of the tactile sensations, disclosed in Applicant's specification at, for example, page 5, lines 22-23, and which is neither disclosed nor suggested by Kramer in view of McIntosh. Claim 47 recites a non-uniform amplitude profile which is also not disclosed nor suggested by these references.

New claims 51-53 are also dependent from claim 41 and are patentable over Kramer and McIntosh for at least the same reasons, and additional reasons; for example, claim 51 recites controlling the actuators in sequence to produce complex tactile sensations having a varying frequency (e.g., page 5, lines 16-23); and claim 52 recites that a series of impulses are generated

(e.g., page 3, lines 18-25). The features of these dependent claims in combination with their parent claims are not disclosed or suggested by Kramer and McIntosh. Claim 53 recites a joystick, which is disclosed in Applicant's specification on page 9, lines 26-32 by way of U.S. Patent No. 5,389,865 (e.g., in col. 5, lines 4-15 of Patent '865) which is incorporated by reference in the present application on page 9, lines 29-30. According to MPEP 608.01(p)I.A., essential or non-essential material disclosed in a U.S. Patent, as in this case, may be incorporated by reference and claimed without having to amend the specification to include the incorporated material. A copy of U.S. Patent 5,389,865 is attached for the Examiner's reference.

Claim 49 has been cancelled without prejudice and not for reasons of patentability, to be pursued in a continuation or other related application; claim 49 is believed patentable over the cited references.

The Examiner rejected claims 30 and 45 under 35 U.S.C. 103(a) as being unpatentable over Kramer and McIntosh, and further in view of McRae et al. (Pat. No. 4,731,603). These claims have been cancelled; however, these cancelled claims and the currently pending claims are patentable over these three references. The pending claims recite rotating mass actuators and particular sensations achieved from the use of the actuators, including a varying frequency, non-uniform sensation, non-uniform amplitude, impulses, etc. McRae's device, in contrast, only operates at a single speed; it is an on-off system in which a constant, single type of vibration is either output or it is not. Since McRae's device is only used for gaining the attention of a user, McRae's device offers nothing but a constant, simple vibration. McRae neither discloses nor suggests non-uniform or varying frequency vibrations or any of the other kinds of sensations recited in the pending claims, or the signal processor or control of the sensations. The more varied or non-uniform sensations of Applicant's inventions allows a much greater variety of tactile sensations than the simple on-off control of McRae allows. Furthermore, for those pending claims reciting a plurality of rotating masses, McCrae does not teach or suggest the use of such multiple rotating masses.

Furthermore, there is no suggestion or motivation in any of Kramer, McIntosh and McRae to combine these references to achieve applicant's invention. Kramer provides a glove device for interfacing with virtual reality environments provided on a computer, and McIntosh discloses a telemanipulator device that controls a remote physical device. McRae discloses a tactile alarm system for gaining the attention of a user (e.g. for a doorbell), which is completely unrelated to the virtual reality glove of Kramer, which uses forces to simulate interactions taking place in a virtual reality, and the telemanipulator device of McIntosh, which uses forces to simulate loads on the remote mechanism. Therefore, it is believed that the pending claims are patentable over Kramer in view of McIntosh and McRae.

The Examiner rejected claims 38, 39, 46, and 47 under 35 U.S.C. 103(a) as being unpatentable over Kramer and McIntosh, and further in view of Renzi (Pat. No. 5,583,478). The Examiner stated that Renzi teaches that a vibration is controlled such that the frequency of the vibration is changed, and so would have been obvious to modify Kramer as modified by McIntosh to have the frequency of the vibration changed as taught by Renzi at col. 6, lines 11-27. Applicant respectfully traverses, and believes these claims are patentable over Kramer in view of McIntosh and Renzi as amended and in pre-amended form. Claim 39 is dependent on claim 25, which recites that a rotating-mass actuator imparts a rotating vector force, creating a tactile sensation perceived as one of a vibration, impulse, and series of impulses as depending on the rotation of the mass, where the tactile sensation has a frequency that varies over the duration of the tactile sensation, and controlled by an activating signal produced by a separate signal processor. Kramer, McIntosh (as explained above) and Renzi do not disclose or suggest a rotating-mass actuator imparting a rotating vector force (e.g., Renzi discloses tactile pins), nor do they disclose a separate signal processor that receives data from a host computer running a graphical simulation, as recited in claim 25. In addition, col. 6, lines 11-27 of Renzi, to which the Examiner refers as disclosing a changing frequency, only refers to the frequency and tactile sensitivity of a human hand, not the frequency of tactile sensations output by the device. Furthermore, it is not stated in Renzi that tactile sensations are caused by an activating signal to have a frequency that varies over the duration of the tactile sensation; Renzi states that a particular frequency or amplitude of sensation is selected for a sensation, but not that the frequency is varied during the sensation once the sensation is turned on, e.g. the "processor transmits a unique waveform specified by its operating program to each actuator. Each actuator contacts the skin at the amplitude and frequency specified by the processor" (Renzi, col. 5, lines 24-30). Once Renzi turns on a sensation, the sensation is output at a constant frequency.

In addition, claim 39 additionally recites that the magnitude of the vibration is varied during the tactile sensation. As with frequency, there is no teaching in Renzi that a magnitude of a sensation is varied during the sensation.

Additionally, there is no suggestion or motivation in any of Kramer, McIntosh and Renzi to combine these references to achieve applicant's invention. Kramer's glove and McIntosh's telemanipulator device do not suggest the rotating masses as recited in the claims, as explained above. Renzi and Kramer are concerned with cable-driven forces or texture-simulating pins (or similar devices) which are not related to rotating masses, the control thereof, or the sensations derived therefrom as recited in claim 25.

Furthermore, Renzi in combination with Kramer and McIntosh do not disclose or suggest the invention of claim 25 even in the form of claim 25 prior to this amendment. None of these references disclose an inertial actuator or controlling an inertial actuator, where the apparatus provides sensor data to a host computer running a graphical simulation. The actuators of Renzi

are pins that are moved against the skin of the user, not inertial actuators. Applicant therefore believes that claim 39 is patentable.

Claims 46 and 47 are dependent from claim 41, which is also believed patentable over Kramer, McIntosh, and Renzi in amended form and in the form prior to this amendment for reasons similar to claim 25. Kramer, McIntosh and Renzi do not disclose rotating-mass actuators imparting a rotating vector force, nor do they disclose a separate signal processor that receives data from a host computer running a graphical simulation, as recited in claim 41. In addition, it is not stated in Renzi that tactile sensations are non-uniform over the duration of the tactile sensation, since Renzi outputs a sensation of pre-defined amplitude and frequency. In addition, these references do not disclose using a plurality of rotating mass actuators to together create a vibrating tactile sensation. The extending pins of Renzi, for example, each produces its own sensation on its own area of the user's fingertip, but the actuators do not create rotating vector forces that together create a tactile sensation as recited in claim 41. Furthermore, Kramer, McIntosh, and Renzi do not disclose or suggest the invention of claim 41 in its form prior to this amendment. None of these references disclose inertial actuators or controlling inertial actuators, where the apparatus provides sensor data to a host computer running a graphical simulation.

Furthermore, claims 46 and 47 recite additional features patentable over these three references. Claims 46 and 47 a non-uniform amplitude profile, which is not taught by Renzi as explained above with reference to claim 39. Applicant therefore believes that claims 39, 46, and 47 are patentable, and respectfully requests that the rejection be withdrawn.

Independent claims 54-58 have been added by this amendment. Claim 54 recites a method for controlling a <u>plurality of rotating mass actuators</u> to create <u>in combination</u> a vibration with a <u>non-uniform amplitude during the duration of the vibration and in coordination with a computer simulation</u>. Claim 55 recites a method for controlling a plurality of rotating mass actuators, each with a different frequency profile, to create a sensation with a <u>varying frequency</u> over a duration of the sensation and in coordination with a computer simulation. Claim 57 recites a method including enabling activations of a plurality of rotating mass actuators, each with a different frequency profile, to create a tactile sensation that has a non-uniform amplitude over a duration of the tactile sensation and in coordindation with a computer simulation. These claims are believed patentable over the references cited by the Examiner for at least similar reasons as explained above for claims 25, 41, and other claims with similar features to features of claims 54, 55, and 57, and for reasons of their additional and/or different features which are not disclosed or suggested in the references relied on by the Examiner. Claim 56 is dependent on claim 55 and claim 58 is dependent on claim 57, and are believed patentable for at least the same reasons as their respective parent claims, and for additional reasons.

All pending claims are believed patentable and Applicant requests a Notice of Allowance from the Examiner. Should the Examiner have any questions or believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below.

Respectfully submitted,

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MARKED-UP VERSION OF AMENDMENTS

In the Claims:

25. (amended) A computer peripheral connected to a host computer for enabling a user to provide input to a graphical simulation running on said host computer and for providing vibration feedback to said user, said vibration feedback corresponding with displayed interactions within said graphical simulation, said computer peripheral comprising:

an analog sensor responsive to [finger motion of] manipulation by a user during operation of said computer peripheral;

[an inertial] a rotating-mass actuator including a shaft and an eccentric mass mounted on said shaft, [that selectively generates an inertial vibration that a user can feel when operating said computer peripheral] said rotating-mass actuator operative to impart a rotating vector force upon said user, said rotating vector force creating a tactile sensation upon said user that is perceived by said user as one of a vibration, an impulse, and a series of impulses depending upon a speed of rotation and a number of rotations of said mass, said rotating mass actuator capable of providing all of said vibration, impulse, and series of impulses, said speed of rotation and said number of rotations being controlled by a profile of an activating signal provided to said rotating-mass actuator, said activating signal causing said tactile sensation to have a frequency that varies over the duration of said tactile sensation; and

a signal processor separate from said host computer, said signal processor connected to said analog sensor and said [inertial] rotating-mass actuator, said signal processor operative to communicate with said host computer, wherein said signal processor sends information to said host computer including sensor data from said analog sensor, and wherein said signal processor controls said [inertial] rotating-mass actuator to produce said [inertial vibration] tactile sensation by [producing] generating said [an] activating signal in response to received variable data from said host computer.

26. A computer peripheral as recited in claim 25 wherein said signal processor includes a computer processor.

27. A computer peripheral as recited in claim 25 wherein said displayed interaction is the collision of two virtual objects within said graphical simulation.

28. (amended) A computer peripheral as recited in claim 25 wherein said [inertial] rotating-mass actuator is a first [inertial] rotating-mass actuator, and further comprising a second [inertial] rotating-mass actuator, said second [inertial] rotating-mass actuator controlled by said signal processor in response to data received from said host computer.

29. (amended) A computer peripheral as recited in claim 28 wherein said first [inertial] rotating-mass actuator and said second [inertial] rotating-mass actuator are controlled simultaneously to produce said tactile sensation [complex tactile feedback sensations] felt by said user.

Please cancel claims 30 and 31 without prejudice.

32. A computer peripheral as recited in claim 25 wherein said computer simulation includes a graphical representation of a human body part, wherein the motion of said graphical representation of said human body part is updated in response to changes in data from said analog sensor.

33. A computer peripheral as recited in claim 32 wherein said human body part is a graphical representation of a human hand.

34. (amended) A computer peripheral as recited in claim 33 wherein said [vibration feedback] tactile sensation corresponds with a displayed collision between said graphical representation of said human hand and another displayed graphical object within said graphical simulation.

35. (amended) A computer peripheral as recited in claim 25 wherein said [inertial] rotating-mass actuator is mounted on a compliant spring to amplify said [inertial] vibration.

36. A computer peripheral as recited in claim 25 wherein said analog sensor is a potentiometer.

37. A computer peripheral as recited in claim 25 wherein said analog sensor is an optical sensor.

Please cancel claim 38 without prejudice.

39. (amended) A computer peripheral as recited in claim [38] 25 wherein said [inertial] vibration is controlled such that the magnitude of said vibration is varied [over time] during said tactile sensation.

Please cancel claim 40 without prejudice.

41. (amended) An apparatus in communication with [A computer peripheral connected to] a host computer for enabling a user to control a graphical simulation running on said host computer and for providing vibration feedback to said user, said vibration feedback corresponding with displayed interactions within said graphical simulation, said apparatus [computer peripheral] comprising:

[an analog] a sensor responsive to [finger motion of] manipulation by a user during operation of said apparatus [computer peripheral];

a plurality of [inertial] rotating-mass actuators, each actuator comprising a shaft and an eccentric mass mounted on said shaft, each of said rotating-mass actuators operative to impart a rotating vector force upon said user in response to an activating signal, said plurality of rotating vector forces together creating a vibrating tactile sensation upon said user that is non-uniform over the duration of said tactile sensation [that selectively generate vibrations that a user can feel when operating said computer peripheral, said vibrations generated by imparting an angular velocity on a mass associated with each of said inertial mass actuators]; and

a signal processor separate from said host computer, said signal processor connected to said [analog] sensor and each of said [inertial] rotating-mass actuators, said signal processor operative to communicate with said host computer, wherein said signal processor is operative to send [sends] information to said host computer including sensor data [from said analog sensor], and wherein said signal processor is operative to selectively control [controls said] the angular velocity of each of said [inertial] rotating-mass actuators to produce said non-uniform tactile sensation [vibrations of controllable magnitude and frequency] in response to received data from said host computer.

42. (amended) [A computer peripheral] An apparatus as recited in claim 41 wherein said signal processor includes a computer processor.

43. (amended) [A computer peripheral] An apparatus as recited in claim 41 wherein said displayed interaction is the collision of two virtual objects within said graphical simulation.

Please cancel claims 44-45 without prejudice.

46. (amended) [A computer peripheral] An apparatus as recited in claim 41 wherein said rotating-mass actuators are controlled in sequence, each actuator having a non-uniform amplitude profile over the duration of said tactile sensation [inertial vibration is controlled such that the frequency of said vibration is varied over time].

47. (amended) [A computer peripheral] An apparatus as recited in claim 41 wherein said [inertial vibration] tactile sensation is controlled such that said tactile sensation has a non-

uniform amplitude profile over the duration of said tactile sensation [the magnitude of said vibration is varied over time].

Please cancel claim 48 without prejudice.

Please cancel claim 49 without prejudice.

Please add the following claims:

50. (new) A computer peripheral as recited in claim 25 wherein said signal processor causes said rotating-mass actuator to generate said series of impulses by repeating pulses of actuation to said actuator.

51. (new) An apparatus as recited in claim 41 wherein said rotating-mass actuators are controlled in sequence to produce complex tactile feedback sensations felt by said user, said complex tactile sensations having a varying frequency over the duration of said complex tactile sensations.

52. (new) An apparatus as recited in claim 41 wherein said rotating-mass actuators generate a series of individual impulses felt by said user.

53. (new) An apparatus as recited in claim 41 further including a joystick manipulatable by said user.

54. (new) A method of controlling a plurality of rotating mass actuators to provide tactile feedback to a user providing input to a computer simulation, said tactile feedback corresponding with displayed interactions within said computer simulation, said method comprising:

providing a plurality of rotating-mass actuators, each of said rotating-mass actuators under electronic control, each of said rotating-mass actuators comprising a shaft and an eccentric mass mounted on said shaft, each of said rotating-mass actuators imparting a rotating vector force upon said user in response to an activating signal and in coordination with said computer simulation; and

enabling control of said plurality of rotating-mass actuators to create in combination a vibration upon said user with an amplitude that is non-uniform over a duration of said vibration.

55. (new) A method of controlling a plurality of rotating mass actuators to provide tactile feedback to a user providing input to a computer simulation, said tactile feedback corresponding with displayed interactions within said computer simulation, said method comprising:

providing a plurality of rotating-mass actuators, each of said rotating-mass actuators under electronic control, each of said rotating-mass actuators comprising a shaft and an eccentric mass mounted on said shaft, each of said rotating-mass actuators imparting a rotating vector force upon said user in response to an activating signal and in coordination with said computer simulation; and

enabling activation of said plurality of rotating-mass actuators, each of said rotating-mass actuators rotating with a different frequency profile such that a tactile sensation caused by said actuators is created upon said user with a varying frequency over a duration of said tactile sensation.

56. (new) A method as recited in claim 55 wherein said plurality of actuators are activated in sequence.

57. (new) A method of controlling a plurality of rotating mass actuators to provide tactile feedback to a user providing input to a computer simulation, said tactile feedback corresponding with displayed interactions within said computer simulation, said method comprising:

providing a plurality of rotating-mass actuators, each of said rotating-mass actuators under electronic control, each of said rotating-mass actuators comprising a shaft and an eccentric mass mounted on said shaft, each of said rotating-mass actuators imparting a vibration upon said user in response to an activating signal and in coordination with said computer simulation; and

enabling activations of said plurality of rotating mass actuators, each of said activations having an amplitude profile different from said other activations to create a tactile sensation upon the user that has a non-uniform amplitude over a duration of said tactile sensation.

58. (new) A method as recited in claim 57 wherein said activations of said rotating mass actuators are sequenced.